

of the problem. Thus the effective zero has become the point at which metabolism begins for any type at a given relative humidity.

The greater mass of investigations, from which the earlier theories were derived, were made in north temperate regions where the effects of low temperatures were noted predominantly, and those of high temperatures comparatively little observed. The present studies were made by the writer of the paper and Mr. W. D. Hunter while in charge of a cotton boll-weevil force operating principally in Texas and Louisiana from 1902 to 1915. Thermohygrograph records of the free air were kept during the experiments, and artificial high and low temperature investigations were conducted, the former with "definite humidity control in order to determine the effects of heat" upon the boll-weevil. The diagram (fig. 1) expresses zone relationship found between temperature and humidity and the life activities of the insect from metabolism to death. A study of the cases of thousands of weevils taken individually disclosed their maximum efficiency to lie approximately at an average temperature of 83° F. and 65 per cent relative humidity. The temperatures and humidities at which dormancy and death ensue cover a wide range of absolute extremes.

The writer confesses to much difficulty in arriving at his first zero, since "only by a laborious series of testings can [it] \* \* \* be approximated, unless the worker finds it by a fortunate chance." All the records of a given average humidity were tabulated together, and the zones of effective temperatures had to be arrived at individually for each moisture per cent.—W. E. H.

#### THE USE OF THE CLIMOGRAPH AS A TEST FOR WEATHER.

By M. McCALLUM FAIRGRIEVE.<sup>1</sup>

(Author's Summary.)

Summing up these observations we may say that while the yearly climographs of a district or districts may

resemble each other, the climographs from year to year, in Western Europe at all events, are widely different.

The very variability of the climograph may be one of the important and omitted factors of the question; the climograph in fact seems even more useful as a test of weather than as a test of climate. If a place or district has a very variable climate, its average climograph for a number of years may be of relatively small size, and may thus give the impression of a climate with but slight variations; its beneficial irregularities may not tell, while another place with but slight variations from normal will seem more comfortable than it is. And so, while welcoming the appearance of the climograph for the general average conditions as used by Dr. Taylor, it seems still more useful as a representation of the shorter period.

A typical climograph should not be based too much upon town readings; but one test of a natural region in this connection is the resemblance of climographs of individual stations in it.

Perhaps an instrument which continuously recorded for a month or year on a fixed sheet of paper the climograph coordinates, relative humidity and temperature, would be a useful variation of the climograph idea, as it would give the definite unaveraged facts for each station. Of course the resulting continuous curves drawn by the pen of the instrument would overlap; but the picture would give not only particulars of temperature and humidity, but also a good idea of their variability, i. e., it would give practically three sets of coordinates on one sheet of paper.

A word of warning may not be amiss that the average yearly conditions are not given by the centroid of the climograph as might be hastily assumed; the diagrams have no time coordinates, and points close together have not the effect of weighting the observations toward themselves. Thus in climographs for Scotland the points representing the winter months tend to come together about 40°, but the average looks as if it were very much higher.

<sup>1</sup> Jour. Scottish Meteorological Soc., 1916, vol. 17, pp. 148-155.